

MANAGEMENT INFORMATION SYSTEM
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1.1 INTRODUCTION

Over the years, a transformation to an information society has been taking place, and computers and telecommunications technologies have changed the way that organizations operate. We live in an information age, and no business of any size can survive and compete effectively without embracing information technology. Information is a resource of fundamental importance to an organization. It is necessary to understand how to apply modern technology in a business in order to achieve the goal of the organization. Information is the key to effective planning and efficient management of any organization and Information collected, stored and analyzed under the Management Information System (MIS) can be directly utilized by the management for both day-to-day operations and for planning. Secondly, managers can obtain summary information from the MIS that can aid effective management.

The value of information is directly linked to how it helps decision makers achieve the organization's goal. Knowing the potential impact of MIS can result in organizations that reach their goals and a society with a higher quality of life. The use MIS adds value to the organization and can also give an organization a competitive edge over competitor. MIS personnel are the key to unlock the potentials of any new or modified system.

Most of the information used by the management is obtained from the **internal** operations of the company. However, **external** information about the environment in which the organization exists is also important to all organizations. This may include:

- Intelligence gathering about competitors' activities;
- Information about population shifts;
- Economic and social factors;
- Government legislation.

This type of information is of great importance to managers who are trying to cut production costs, find new markets, develop new products, or have strategic decisions to make about the future direction of the company. Information is collected in many ways – through conversations

and interpersonal 'networking', reading newspapers, trade reviews and magazines, attending conferences and meetings, browsing the Internet.

The role of a management information system is to convert data from internal and external sources into information that can be used to aid effective decisions making. An organization may have different type information systems, some of which are useful for the day-to-day operational decisions, and some of which are used in making tactical and strategic decisions.

2.1 CONCEPT OF INFORMATION AND DATA

To be an effective manager one needs to understand that information is one of the organization's valuable and important resources. This term however, is often confused with data. Data consists of raw facts such as an employee's name, no of hours worked in a week, sale order etc. several types of data can be used to represent these facts. When these facts are organized or arranged in a meaningful manner, they become information. Information is a collection of facts (data) organized in such a way that they have additional value beyond the value of the facts themselves. Defining and organizing relationships amongst data creates information.

Each organization, regardless of its size or purpose, generates data to keep record of events and transactions that take place within the business. Generating and organizing this data in a useful way is called data processing. The word "data" is the plural of datum, which means fact, observation, assumption or occurrence. More precisely, data are representations of facts pertaining to people, things, ideas and events. Data are represented by symbols such as letters of the alphabets, numerals or other special symbols.

Information thus can be defined as "data that has been transformed into a meaningful and useful form for specific purposes". In some cases data may not require any processing before constituting information. However, generally, data is not useful unless it is subjected to a process through which it is manipulated and organized, its contents analyzed and evaluated. Only then data becomes information. Data is unprocessed information waiting to be processed by the computer while information is data that has already been processed into a useful form.

2.2 TYPES OF DATA

Alphanumeric Data: this represents numbers, letters, and other characters

Image Data: this represents graphic images, and pictures

Audio Data: this represents sounds, noise or tones

Video Data: this represents moving images or pictures.

2.3 THE PROCESS OF TRANSFORMING DATA INTO INFORMATION

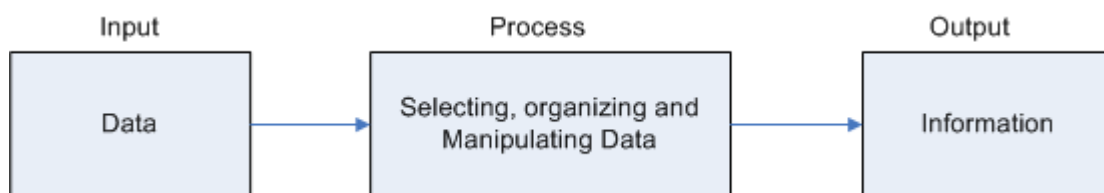


Figure 1: Information Process

Data: are streams of raw facts representing events occurring in organizations or the physical environment before they are organized and arranged into a form that people can understand and use.

Information: is data that have been shaped into a form that is meaningful and useful to human understanding.

In information system:

Input is the activity of gathering and capturing raw data.

Processing is the activity of converting or transforming data into useful outputs

Output the production of useful information usually in form of documents or reports

Feedback is the output that is used to make changes to input or processing activities.

2.4 CHARACTERISTICS OF VALUABLE INFORMATION

Accurate: Accurate information is error free. In some cases, inaccurate information is generated because inaccurate data is fed into the transformation process (this is commonly called garbage in, garbage out [GIGO]).

Complete: Complete information contains all the important facts. For example, an investment report that does not include all-important costs is not complete.

Economical: Information should also be relatively economical to produce. Decision makers must always balance the value of information with the cost of producing it.

Flexible: Flexible information can be used for a variety of purposes. For example, information on how much inventory is on hand for a particular part can be used by a sales representative in closing a sale, by a production manager to determine whether more inventory is needed, and by a financial executive to determine the total value the company has invested in inventory.

Reliable: Reliable information can be depended on. In many cases, the reliability of the information depends on the reliability of the data collection method. In other instances, reliability depends on the source of the information. A rumor from an unknown source that oil prices might go up may not be reliable.

Relevant: Relevant information is important to the decision maker. Information that lumber prices might drop may not be relevant to a computer chip manufacturer.

Simple: Information should also be simple, not overly complex. Sophisticated and detailed information may not be needed. In fact, too much information can cause information overload, whereby a decision maker has too much information and is unable to determine what is really important.

Timely: Timely information is delivered when it is needed. Knowing last week's weather conditions will not help when trying to decide what coat to wear today.

Verifiable: Information should be verifiable. This means that you can check it to make sure it is correct, perhaps by checking many sources for the same information.

Accessible: Information should be easily accessible by authorized users to be obtained in the right format and at the right time to meet their needs.

Secure: Information should be secure from access by unauthorized users.

2.5 MANAGEMENT OF INFORMATION

Information, as we know it today, includes both electronic and physical information. The organizational structure must be capable of managing this information throughout the information lifecycle regardless of source or format (data, paper documents, electronic documents, audio, video, etc.) for delivery through multiple channels that may include cell phones and web interfaces.

Information management (IM) is the collection and management of information from one or more sources and the distribution of that information to one or more audiences. This sometimes involves those who have a stake in, or a right to that information. Management means the organization of and control over the structure, processing and delivery of information.

Information management is a corporate responsibility that needs to be addressed and followed from the upper most senior levels of management to the front line worker. Organizations must be held and must hold its employees accountable to capture, manage, store, share, preserve and deliver information appropriately and responsibly.

2.6 SECURITY CHECKS ON INFORMATION

Information security means protecting information from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction. Information security is concerned with the confidentiality, integrity and availability of data regardless of the form the data may take: electronic, print, or other forms. The common way of protecting information from unauthorized access is through access control mechanisms.

In many computerized system which stores data that can be accessed by different people, there must be need for adequate provision of security to the data in the database. One common system involves the use of password. Moreover, there is need some times to prevent data from fire or theft, the master files are often kept inside a fireproof safe. Indeed sometimes they are often kept inside a different building. It is usual for personnel to be restricted from sensitive areas of the computer such as master file storage areas. It is easier to protect against accidental loss of data consistency that to protect against malicious access to the data. Absolute protection of the database from malicious abuse is not possible, but the punishment to the perpetrators can be made sufficiently high to deter them from such malicious acts. A user may have several forms of authorization on parts of the database. Authorization is a means by which the computer system can be protected against malicious or unauthorized access. Example of some form of authorization a user may have includes:

- Log in / Open authorization: access not allowed into the system at all
- Read authorization: allows reading not modification
- Insert authorization : allows insertion not modification
- Update authorization: allows modification not deletion
- Delete authorization: allows deletion

3.1 INFORMATION SYSTEM

An Information System (IS) is a set of interrelated components that collect, manipulate, store and disseminate data and information and provide a feedback mechanism to an objective. The feedback mechanism helps organization to achieve their goals such as increasing profits or improving customer service. Computers and information system ar constantly changing the way organizations conduct businesses. They are becoming fully integrated into our lives, businesses and society. They can help organizations carry on daily operations (Operational System)

The difference between Information System (IS), Management Information System (MIS), and Information System Management (ISM)

Information System (IS) is a set of inter-related components that collects, process, store and distribute information to support decision making in an organization. It is an information system that is required to run the day-to-day operations of a company. Organizations use information

systems at all levels of operation to collect, process and store data. The three activities of IS (Input, Process and Output) are used to produce the information that an organization required for its decision making.

Input

In information systems, input is the activity of gathering and capturing raw data.

Processing

In information systems processing involves converting or transforming data into useful outputs.

Output

In information systems, output involves producing useful information usually in the form of documents and reports.

Management aggregates and disseminates this data in the form of information needed to carry out the daily operations of business. Information System Management (ISM) supports the process of collection, manipulation, storage, distribution and utilization of an organization's information resources.

4.1 MANAGERS AND THEIR FUNCTIONS IN AN ORGANIZATION

To understand how information systems can benefit managers, we first need to look at what the functions of management are and the kind of information they need for decision-making.

The five basic functions of managers are:

Planning: Managers plan the direction a company is to take, whether to diversify, which areas of the world to operate in, how to maximize profit.

Organizing: Organized resources such as people, space, equipment and services

Coordinating: coordinate the activities of various departments.

Decision-making: make decisions about the organization, the products or services made or sold, the employees, the use of information technology.

Controlling: This involves monitoring and supervising the activities of others.

Management information systems must be designed to support managers in as many of these functions as possible, at different levels (operation, tactic, and strategy) of an organization.

4.2 LEVEL OF MANAGEMENT DECISION-MAKING

Information systems can support a variety of management decision-making levels and decisions. These include the three levels of management activity: strategic management, tactical management, and operational management.

(i) Strategic management

It is typical for a board of directors and an executive committee of the CEO and top executives to develop the overall organization goals, strategies, policies and objectives as part of a strategic planning process. They also monitor the strategic performance of the organization and its overall direction in the political, economic and competitive business environment.

(ii) Tactical management

Increasingly, business professionals in self-directed teams as well as business unit managers develop short- and medium-range plans, schedules and budgets and specify the policies, procedures and business objectives for their subunits of the company. They also allocate resources and monitor the performance of their organizational sub-units, including departments, divisions, process teams and other workgroups.

(iii) Operational management

The members of self-directed teams or operating managers develop short range plans such as weekly production schedules. They direct the use of resources and the performance of tasks according to procedures, and within budgets and schedules they establish for the teams and other workgroups of the organization.

5.1 OVER VIEW OF A MANAGEMENT INFORMATION SYSTEM (MIS)

Management Information system (MIS) is one of the many sources of managerial information. The primary purpose of an MIS is to help an organization achieve its goal by providing managers with insight into regular operations of the organization so that they can control, organize and plan more effectively and efficiently. One important role of the MIS is to provide the right information to the right person in the right fashion at the right time. In fact, MIS provides managers with information, typically in report form that supports effective decision making and provides feedback on daily operations. MIS can often give companies and other organization a competitive advantage by providing the right information to the right people in the right format and the right time. Data that enters an MIS originates from both internal and external sources

A management information system (MIS) is organized information and documentation service that systematically collects, stores, processes, analyzes; reports and disseminates information and data. It can also be defined as a computerized record keeping system that provides the information necessary to manage an organization effectively. MIS is that system that is used by management to make management decisions. It provides tools and information to managers which help them in decision making. MIS is the study of people, technology, organizations and the relationships among them. Management information systems – provide information in the form of pre specified reports and displays to support business decision making. Examples: sales analysis, production performance and cost trend reporting systems.

5.2 CHARACTERISTICS OF AN EFFECTIVE MIS

Management Information Systems (MIS) provide companies with a method of storing and organizing data into useful information. Management and board executives rely on MIS to measure institutional performances, resource management and risk assessment. Management can also use MIS to communicate with employees and customers. An effective MIS will provide timely, accurate, consistent, complete and relevant information as needed.

Accuracy

Effective MIS may be electronic or manual, but, above all, the data contained within the system must be accurate. Accurate data allow managers and board executives to analyze the information for real risks to the company. Decisions made on accurate data provide for timely decisions to

steer the direction of the company. Inaccurate data waste management's time chasing red-herring problems and incompetency.

Consistency

MIS must disseminate complex information throughout the company. An effective MIS will be used to make relevant decisions at all managerial levels so long as the information contained is consistently added. Companies need to establish input and data collection procedures that all relevant employees follow to ensure uniformity. Establishing a data collection monitoring system will reduce inconsistencies. Communicate all changes in data collection procedures to appropriate compilers.

Objectivity

The information collected and entered into the MIS must be consistent, accurate and objective. Data compilers cannot selectively input information that purposely skews managerial decisions one way or another. The effective MIS contains a methodology for objective recording and assemblage of information.

Completeness

All data recorded in an MIS must be complete. All angles of an issue need to have corresponding data to provide decision-makers with a full view of complex issues and problems. Where reports can be generated, information summaries must not be myopic in scope, to effect positive results.

5.3 TYPES OF MIS

A management information system (MIS) is a computer-based system that provides the information necessary to manage an organization effectively. An MIS should be designed to enhance communication among employees, provide an objective system for recording information and support the organization's strategic goals and direction.

1. TRANSACTION PROCESSING SYSTEM

Transaction-processing systems are designed to handle a large volume of routine, recurring transactions. They were first introduced in the 1960s with the advent of mainframe computers.

Transaction-processing systems are used widely today. Banks use them to record deposits and payments into accounts. Supermarkets use them to record sales and track inventory. Managers often use these systems to deal with such tasks as payroll, customer billing and payments to suppliers.

2. OPERATION INFORMATION SYSTEM

Operations information systems were introduced after transaction-processing systems. An operations information system gathers comprehensive data, organizes it and summarizes it in a form that is useful for managers. These types of systems access data from a transaction-processing system and organize it into a usable form. Managers use operations information systems to obtain sales, inventory, accounting and other performance-related information

3. DECISION SUPPORT SYSTEM

A DSS is an interactive computer system that can be used by managers without help from computer specialists. A DSS provides managers with the necessary information to make informed decisions. A DSS has three fundamental components: database management system (DBMS), which stores large amounts of data relevant to problems the DSS has been designed to tackle; model-based management system (MBMS), which transforms data from the DBMS into information that is useful in decision-making; and dialog generation and management system (DGMS), which provides a user-friendly interface between the system and the managers who do not have extensive computer training.

4. EXPERT SYSTEMS AND ARTIFICIAL INTELLIGENCE

Expert systems and artificial intelligence use human knowledge captured in a computer to solve problems that ordinarily need human expertise. Mimicking human expertise and intelligence requires the computer to do the following: recognize, formulate and solve a problem; explain solutions; and learn from experience. These systems explain the logic of their advice to the user; hence, in addition to solving problems they also can serve as a teacher. They use flexible thinking processes and can accommodate new knowledge.

NOTE: A potential problem with relying on electronic communication and processing of

information is the loss of the vital human element. Sometimes, because of the complexity of information, an MIS report cannot effectively summarize it. Very rich information is needed to coordinate and run an enterprise, and certain classes of information cannot be quantified. For example, it might be wrong to evaluate an employee's performance solely based on numbers generated by an MIS. Numbers can indicate a performance problem, but a face-to-face meeting is necessary to discuss the nature of the problem.

5.4 INFORMATION SYSTEMS THAT ENHANCE VALUE OF INFORMATION

(i) Data warehouse (DW)

A data warehouse stores data that have been extracted from the various operational, external and other databases of an organization. It is a central source of the data that have been cleaned, transformed and catalogued so they can be used by managers and other business professionals for data mining, online analytical processing and other forms of business analysis, market research and decision support.

(ii) Data mining (DM)

Data mining is a major use of DW databases and the static data they contain. In data mining, the data in a DW are analyzed to reveal hidden patterns and trends in historical business activity. This can be used to help managers make decisions about strategic changes in business operations to gain competitive advantages in the marketplace. DM software analyzes the vast stores of historical business data that have been prepared for analysis in corporate DW and tries to discover patterns, trends, and correlations hidden in the data that can help a company improve its business performance.

Data mining – analyzes the vast amounts of historical data that have been prepared for analysis in data warehouses.

(iii) Online analytical processing (OLAP)

Online analytical processing enables managers and analysts to interactively examine and manipulate large amounts of detailed and consolidated data from many perspectives. OLAP

involves analyzing complex relationships among thousands or even millions of data items stored in data marts, DW and other multi-dimensional databases to discover patterns, trends and exceptional conditions. An OLAP session takes place online in real time, with rapid responses to a manager's or analyst's queries, so that their analytical or decision-making process is undisturbed.

Online analytical processing – interactively analyzes complex relationships among large amounts of data stored in multidimensional databases.

5.5 BENEFITS OF MIS

The benefits of MIS systems to businesses, governments, scientists, universities, students, nonprofits and all other entities are diversified. Some of the examples include the following:

- Implementation of Management by Objectives (MBO) techniques: MIS allows all participants, both management and staff, to view, analyze, and interpret useful data to set goals and objectives.
- Generates competitive advantages: Businesses succeed or fail based on how they face competitive challenges. MIS, if implemented properly, provides a wealth of information to allow management to construct effective plans to meet, and beat, their competitors.
- Fast reaction to market changes: The victory often goes to the quick, not necessarily the best. MIS can deliver facts, data and trends to businesses with lightning speed. Having this information allows companies to react quickly to market changes, regardless of the type (positive or negative) of volatility.

5.6 FUNCTION

The function of all MIS systems is identical: manage, massage and manipulate data (or groups of data) in a fashion that enables good decision-making. In the first half of the 20th century, businesses managed information on paper, with detailed filing systems and hand calculated reports.

Contemporary MIS systems involve one or more computers, working in concert, to achieve the stated goals of an organization. The function is always the same, but the desired results fluctuate with the specific goals and needs of individual organizations. Since the universal language of

commerce is numbers, using the incredible speed of computers, MIS systems achieve their function amazingly well.

5.7 EVOLUTIONS OF MIS

Before the 1960s, the role of most information systems was simple. They were mainly used for electronic data processing (EDP), purposes such as transactions processing, record-keeping and accounting. EDP is often defined as the use of computers in recording, classifying, manipulating, and summarizing data. It is also called transaction processing systems (TPS), automatic data processing, or information processing. Transaction processing systems as the name implies process data gotten from business transactions, update operational databases, and produce business documents. Examples: sales and inventory processing and accounting systems.

In the 1960s, another role was added to the use of computers: the processing of data into useful informative reports. The concept of management information systems (MIS) was born. This new role focused on developing business applications that provided managerial end users with predefined management reports that would give managers the information they needed for decision-making purposes.

By the 1970s, these pre-defined management reports were not sufficient to meet many of the decision-making needs of management. In order to satisfy such needs, the concept of decision support systems (DSS) was born. The new role for information systems was to provide managerial end users with ad hoc and interactive support for their decision-making processes.

Decision support systems (DSS) – provide interactive ad hoc support for the decision-making processes of managers and other business professionals. Examples: product pricing, profitability forecasting and risk analysis systems.

In the 1980s, the introduction of microcomputers into the workplace ushered in a new era, which led to a profound effect on organizations. The rapid development of microcomputer processing power (e.g. Intel's Pentium microprocessor), application software packages (e.g. Microsoft Office), and telecommunication networks gave birth to the phenomenon of end user computing. End users could now use their own computing resources to support their job requirements instead

of waiting for the indirect support of a centralized corporate information services department. It became evident that most top executives did not directly use either the MIS reports or the analytical modelling capabilities of DSS, so the concept of executive information systems (EIS) was developed.

Executive information systems – provide critical information from MIS, DSS and other sources, tailored to the information needs of executives. Examples: systems for easy access to analysis of business performance, actions of all competitors, and economic developments to support strategic planning.

Moreover, breakthroughs occurred in the development and application of artificial intelligence (AI) techniques to business information systems. With less need for human intervention, knowledge workers could be freed up to handle more complex tasks. Expert systems (ES) and other knowledge management systems (KMS) also forged a new role for information systems. ES can serve as consultants to users by providing expert advice in limited subject areas.

Expert systems: knowledge-based systems that provide expert advice and act as expert consultants to users. Examples: credit application advisor, process monitor, and diagnostic maintenance systems.

Knowledge management systems: knowledge-based systems that support the creation, organization and dissemination of business knowledge within the enterprise. Examples: intranet access to best business practices, sales proposal strategies and customer problem resolution systems.

The mid- to late 1990s saw the revolutionary emergence of enterprise resource planning (ERP) systems. This organization-specific form of a strategic information system integrates all facets of a firm, including its planning, manufacturing, sales, resource management, customer relations, inventory control, order tracking, financial management, human resources and marketing – virtually every business function. The primary advantage of these ERP systems lies in their

common interface for all computer-based organizational functions and their tight integration and data sharing needed for flexible strategic decision making.

The rapid growth of the Internet, intranets, extranets and other interconnected global networks in the 1990s dramatically changed the capabilities of information systems in business. Internet-based and web-enabled enterprise and global electronic business and commerce systems are becoming commonplace in the operations and management of today's business enterprises. Indeed today's information systems are still doing the same basic things that they began doing over 50 years ago. We still need to process transactions, keep records, provide management with useful and informative reports, and provide support to the accounting systems and processes of the organization. However, what has changed is that we now enjoy a much higher level of integration of system functions across applications, greater connectivity across both similar and dissimilar system components, and the ability to reallocate critical computing tasks such as data storage, processing, and presentation to take maximum advantage of business and strategic opportunities. With increasing capabilities, future systems will focus on increasing both the speed and reach of our systems to provide even tighter integration combined with greater flexibility.

The Internet and related technologies and applications have changed the way businesses operate and people work, and how information systems support business processes, decision-making and competitive advantage. Today many businesses are using Internet technologies to web-enable business processes and to create innovative e-business applications.

E-business is the use of Internet technologies to work and empower business processes, electronic commerce and enterprise collaboration within a company and with its customers, suppliers and other business stakeholders. The Internet and Internet-like networks – those inside the enterprise (intranet) and those between an enterprise and its trading partners (extranet) – have become the primary information technology infrastructure that supports the e-business applications of many companies. These companies rely on e-business applications to: reengineer internal business processes, implement electronic commerce systems with their customers and suppliers, and promote enterprise collaboration among business teams and workgroups.

6.1 SYSTEM DEVELOPMENT CYCLE

The systems development life cycle (SDLC) is an approach for designing and developing MIS solutions. It proceeds in stages: feasibility study, requirements analysis, design, development, and implementation.

MIS is designed using the systems development life cycle (SDLC). The SDLC is developed in stages. The first stage is to do a feasibility study to know the system is worthwhile, analyze the current situation. Then specify the requirements that the solution should contain. The next stage is to design a solution (no programming yet). Then the system is developed (programmed) and tested. Finally, the system goes live for the end users as it is implemented in the business setting.

The five phases are:

1. Feasibility Study
2. Requirement Analysis
3. Design
4. Development
5. Implementation

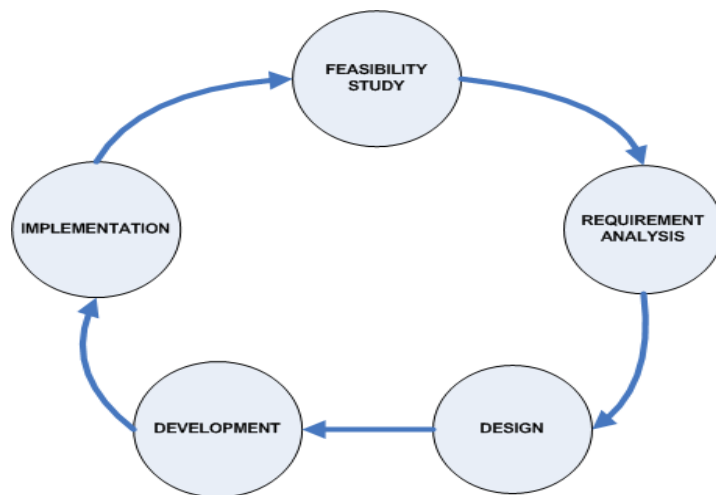


Figure 2: A system Development Life Cycle

1. Feasibility study

This is the first stage of the systems life cycle. The **scope** and **objectives** of the proposed system must be written down. The aim of the feasibility study is to understand the problem and to determine whether it is worth proceeding. There are five main factors to be considered:

Technical feasibility means investigating whether the technology exists to implement the proposed system, or whether this is a practical proposition.

Economic feasibility has to do with establishing the cost-effectiveness of the proposed system if the benefits do not outweigh the costs, then it is not worth going ahead.

Legal feasibility determines whether there is any conflict between the proposed system and legal requirements – for example, will the system contravene the Data Protection Act?

Operational feasibility is concerned with whether the current work practices and procedures are adequate to support the new system. It is also concerned with social factors – how the organizational change will affect the working lives of those affected by the system.

Schedule feasibility looks at how long the system will take to develop, or whether it can be done in a desired time-frame.

The completion of this stage is marked by the production of a feasibility report produced by the systems analyst. If the report concludes that the project should go ahead, and this is agreed by senior managers, detailed requirements analysis will proceed.

2. Requirements analysis

The second phase of systems analysis is a more detailed investigation into the current system and the requirements of the new system.

Gathering details about the current system will involve:

- Interviewing staff at different levels of the organization from the end-users to senior management.
- Examining current business and systems documents and output. These may include current order documents, computer systems procedures and reports used by operations and senior management.
- Sending out questionnaires and analyzing responses. The questions have to be carefully constructed to elicit unambiguous answers.
- Observation of current procedures, by spending time in various departments. A time and motion study can be carried out to see where procedures could be made more efficient, or to detect where bottlenecks occur.

The systems analyst's report will examine how data and information flow around the organization, and may use **data flow diagrams** to document the flow. It will also establish precisely and in considerable detail exactly what the proposed system will do (as opposed to how it will do it). It will include an in depth analysis of the costs and benefits, and outline the process of system implementation, including the organizational change required. It must establish who the end-users are, what information they should get and in what form and how it will be obtained.

Alternative options for the implementation of the project will be suggested. These could include suggestions for:

- Whether development should be done in-house or using consultants;
- What hardware configurations could be considered;
- What the software options are.

The report will conclude with a recommendation to either proceed or abandon the project.

3. System design

The design specifies the following aspects of a system:

- The hardware platform – which type of computer, network capabilities, input, storage and output devices;
- The software – programming language, package or database;
- The outputs – report layouts and screen designs;
- The inputs – documents, screen layouts and validation procedures;
- The user interface – how users will interact with the computer system;
- The modular design of each program in the application;
- The test plan and test data;
- Conversion plan – how the new system is to be implemented;
- Documentation including systems and operations documentation. Later, a user manual will be produced.

4. System Development

This phase includes both the coding and testing of the system, the acquisition of hardware and software.

5. Implementation

This phase involves the installation of the new system or conversion of the old system to the new one. The installation phase can include:

- Installing the new hardware, which may involve extensive re-cabling and changes in office layouts;
- Training the users on the new system;
- Conversion of master files to the new system, or creation of new master files.

6.2 METHODS OF CONVERSION

There are several different methods of conversion:

- **Direct changeover.** The user stops using the old system one day and starts using the new system the next — usually over a weekend or during a slack period. The advantage of this system is that it is fast and efficient, with minimum duplication of work involved. The disadvantage is that normal operations could be seriously disrupted if the new system has errors in it or does not work quite as expected.
- **Parallel conversion.** The old system continues alongside the new system for a few weeks or months. The advantage is that results from the new system can be checked against known results, and if any difficulties occur, operations can continue under the old system while the errors or omissions are sorted out. The disadvantage of parallel conversion is the duplication of effort required to keep both systems running, which may put a strain on personnel.
- **Phased conversion.** This is used with larger systems that can be broken down into individual modules that can be implemented separately at different times. It could also be used where for example only a few customer accounts are processed using the new system, while the rest remain for a time on the old system. Phased conversion could be direct or parallel.

- **Pilot conversion.** This means that the new system will be used first by only a portion of the organization, for example at one branch or factory.

6.3 POST-IMPLEMENTATION REVIEW

An important part of the implementation is a review of how the new system is performing, once it has been up and running for a period of time. Minor programming errors may have to be corrected, clerical procedures amended, or modifications made to the design of reports or screen layouts. Often it is only when people start to use a new system that they realise its shortcomings! In some cases they may realize that it would be possible to get even more useful information from the system than they realized, and more programs may be requested. The process of **system maintenance**, in fact, has already begun, and the life cycle is complete.

6.4 SYSTEM MAINTENANCE

All software systems require maintenance, and in fact the vast majority of programmers are employed to maintain existing programs rather than to write new ones. There are differing reasons for this, and different types of maintenance.

- **Perfective maintenance:** This implies that while the system runs satisfactorily, there is still room for improvement. For example, extra management information may be needed so that new report programs have to be written. Database queries may be very slow, and a change in a program may be able to improve response time.
- **Adaptive maintenance:** All systems will need to adapt to changing needs within a company. As a business expands, for example, there may be a requirement to convert a standalone system to a multiuser system. New and better hardware may become available, and changes to the software may be necessary to take advantage of this. New government legislation may mean that different methods of calculating tax, for example, are required. Competition from other firms may mean that systems have to be upgraded in order to maintain a competitive edge.

- **Corrective maintenance:** Problems frequently surface after a system has been in use for a short time, however thoroughly it was tested. Some part of the system may not function as expected, or a report might be wrong in some way; totals missing at the bottom, incorrect sequence of data, wrong headings, etc. Frequently errors will be hard to trace, if for example a file appears to have been wrongly updated.

7.1 PROTOTYPING

The waterfall model of the system life cycle has major shortcomings and often bears little relation to what happens in practice. One reason for this is that it doesn't allow for modifications to the design as the project proceeds, with both user and developer learning as they go along. Users frequently have difficulty in explaining their requirements at the start of a proposed system since they do not know what is possible and cannot visualize how the final system will work. This can result in a system which does not really match their requirements. Using the **prototyping** approach, a model of a new system is built in order to evaluate it or have it approved before building the production model. Applied to software projects, this means, for example, using special software to quickly design input screens and create a program to input and validate data.

This gives the user a chance to experience the 'look and feel' of the input process and suggest alterations before going any further. The earlier a user is involved, the easier it will be to make changes.

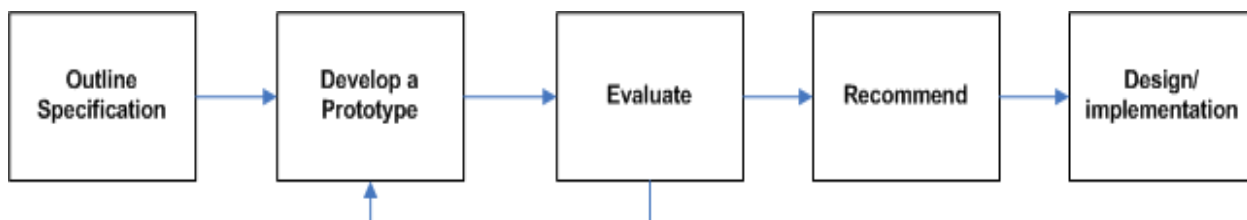


Figure 3: Prototyping Work Flow

7.2 BENEFITS OF PROTOTYPING

The benefits of prototyping are:

- Misunderstandings between software developers and users can be identified when the prototype is demonstrated;

- Missing functions may be detected;
- Incomplete or inconsistent user requirements may be detected and can be completed or corrected;
- A prototype version will be quickly available to demonstrate the feasibility and usefulness of the proposed system to management;
- The prototype can sometimes be used for training before the final system is delivered.

Prototyping may be used in a number of different ways, and various terms have been coined to describe them:

- **Piloting** – using a prototype to test the feasibility of a design proposal;
- **Modeling** – building to develop an understanding of the user's requirements;
- **Throw-away prototyping** – both piloting and modeling are 'throw-away prototypes': once they have achieved their purpose the real system is built;
- **Evolutionary prototyping** – each prototype built represents a step closer to the final solution.

8.1 INFORMATION STORAGE DEVICES

Physical components or materials on which data is stored are called storage media.

Hardware components that read/write to storage media are called storage devices. eg the floppy disk is the storage medium while the floppy drive is the storage device

Two main categories of storage technology used today are:

1) Magnetic or Optical disk: these are direct access media and are the primary means of storing files on-line. E.g.:

Primary magnetic storage

- Diskettes
- Hard disks (both fixed and removable)
- High capacity floppy disks
- Disk cartridges

Primary optical storage

- Compact Disk Read Only Memory (CD ROM)
- Digital Video Disk Read Only Memory (DVD ROM)

- CD Recordable (CD R)
- CD Rewritable (CD RW)
- Photo CD

2) Magnetic Tape: this medium has significant limitations because it is a serial access method e.g. magnetic tapes.

Magnetic tape has long history of use as a secondary storage medium. Although it is relatively permanent and holds large volumes of data, magnetic tape is slow in comparison to magnetic and optical disks. Magnetic tape is limited to sequential (serial) access. Tapes are used mainly for back up, for storage of infrequently used information and as an off-line medium for transferring information from one system to another. Magnetic or optical disks are the most popular storage medium.